

Spatial-Temporal Large Language Model for Traffic Prediction

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Abstract

Traffic prediction, an essential component for intelligent transportation systems, endeavours to use historical data to foresee future traffic features at specific locations. Although existing traffic prediction models often emphasize developing complex neural network structures, their accuracy has not improved. Recently, large language models have shown outstanding capabilities in time series analysis. Differing from existing models, LLMs progress mainly through parameter expansion and extensive pretraining while maintaining their fundamental structures. Motivated by these developments, we propose a Spatial-Temporal Large Language Model (ST-LLM) for traffic prediction. In the ST-LLM, we define timesteps at each location as tokens and design a spatial-temporal embedding to learn the spatial location and global temporal patterns of these tokens. Additionally, we integrate these embeddings by a fusion convolution to each token for a unified spatial-temporal representation. Furthermore, we innovate a partially frozen attention strategy to adapt the LLM to capture global spatial-temporal dependencies for traffic prediction. Comprehensive experiments on real traffic datasets offer evidence that ST-LLM is a powerful spatial-temporal learner that outperforms state-of-the-art models. Notably, the ST-LLM also exhibits robust performance in both few-shot and zero-shot prediction scenarios. The code is publicly available at <https://github.com/ChenxiLiu-HNU/ST-LLM>.